REMARKS

Reconsideration is requested in view of the above amendments and the following remarks. Claim 16 has been revised to include the feature of claim 17. Claims 18-20 have been revised to depend from claim 16. Claims 17, 21 and 27-28 have been canceled without prejudice. New claims 29-39 have been added. No new matter has been introduced. Claims 16, 18-20, 22-26 and 29-39 are pending in the application.

New independent claim 30 tracks previous claim 16 and further includes the feature of previous claim 21. New claims 31-38 track claims 18-20 and 22-26 respectively. With respect to new claims 29 and 39, support can be found at page 10, lines 8-10 of the specification, among other places.

Claim Rejections – 35 USC § 103

Claims 16-23 are rejected under 35 USC § 103(a) as being unpatentable over Shimoyama et al. (JP 2000-312052). Applicant respectfully traverses this rejection. Claims 17 and 21 have been canceled without prejudice. Applicant is not conceding the correctness of the rejection.

Claim 16 requires a width of a bottom portion of a ridge in a first region to be in a range of 1.8 μm to 2.5 μm and a width of a bottom portion of a ridge in a second region to be in a range of 2.4 μm to 3 μm. Claim 16 also requires a length of the first region to be 10% to 50% with respect to a resonator length.

The configuration that the first region is 10% to 50% with respect to the resonator length advantageously reduces the differential resistance (R_S) of current-voltage characteristics of the semiconductor laser device and, as a result, allows an operation voltage to be reduced, which in turn permits a lower operation power. This significantly improves the temperature characteristics and reliability of the semiconductor laser device. Moreover, since the length of the first region is at most 50% of the resonator length, the second region can be sufficiently long. Thus, even if the difference between the widths of the first region and the second region increases, a sharp increase in a taper angle in the second region can be avoided. This helps suppress an increase in a waveguide loss of the semiconductor laser device, which in turn helps suppress the decrease of the slope

efficiency and advantageously achieves high light output (see generally page 7, line 36 to page 10, line 31 of the present specification).

Shimoyama et al. do not suggest the invention of claim 16. Shimoyama et al. discuss a central region having a constant width of Wc (marked as "first region" in the Examiner revised drawing at page 4 of the Office Action) and an outer region (marked as "second region" in the Examiner revised drawing at page 4 of the Office Action), where the outer region includes a constant portion with a width of W_F or W_R and a tilted portion between the central region and the constant portion of the outer region.

Shimoyama et al. fail to suggest obtaining a lower differential resistance (R_S) of current-voltage characteristics by reducing the length of a first region relative to the entire resonator length. Nor do Shimoyama et al. suggest obtaining higher light output by increasing the length of the second region relative to the resonator length and in turn limiting the taper angle of the second region. On the other hand, the reference merely seeks to achieve low operation current by reducing the width Wc of the central portion or to obtain high light output by forming a constant portion between a tilted portion of the outer region and an end face (see Shimoyama et al., Abstract and paragraphs [0027]-[0029]). Shimoyama et al. do not suggest any reason to modify the configuration by reducing the length of a first region relative to the entire resonator length, much less a length of the first region being 10% to 50% with respect to a resonator length, as required by claim 16.

Therefore, Shimoyama et al. provides no reasonable basis to adopt the structure required by claim 16, nor any reasonable basis to expect the advantageous property enjoyed by the present invention.

Moreover, the configuration that the first region is 10-50% with respect to the resonator length is not merely an optimization. The invention of claim 6 produces significant results that are different in kind from Shimoyama et al.

Paragraph [0055] of Shimoyama et al. discusses a central region having a length of 400 μm and an outer region having a length of 50 μm, where the outer region includes a tilted portion of 30 μm and a constant portion of 20 μm (see Shimoyama et al., paragraphs [0055] and Fig. 3(a)). Paragraph [0063] of Shimoyama et al. discusses a

central region having a length of 300 μm and an outer region having a length of 50 μm, where the outer region includes a tilted portion of 30 μm and a constant portion of 20 μm (see Shimoyama et al., paragraphs [0063] and Fig. 3(a)). In either case, the Shimoyama et al. central region is 75% or more of the resonator length.

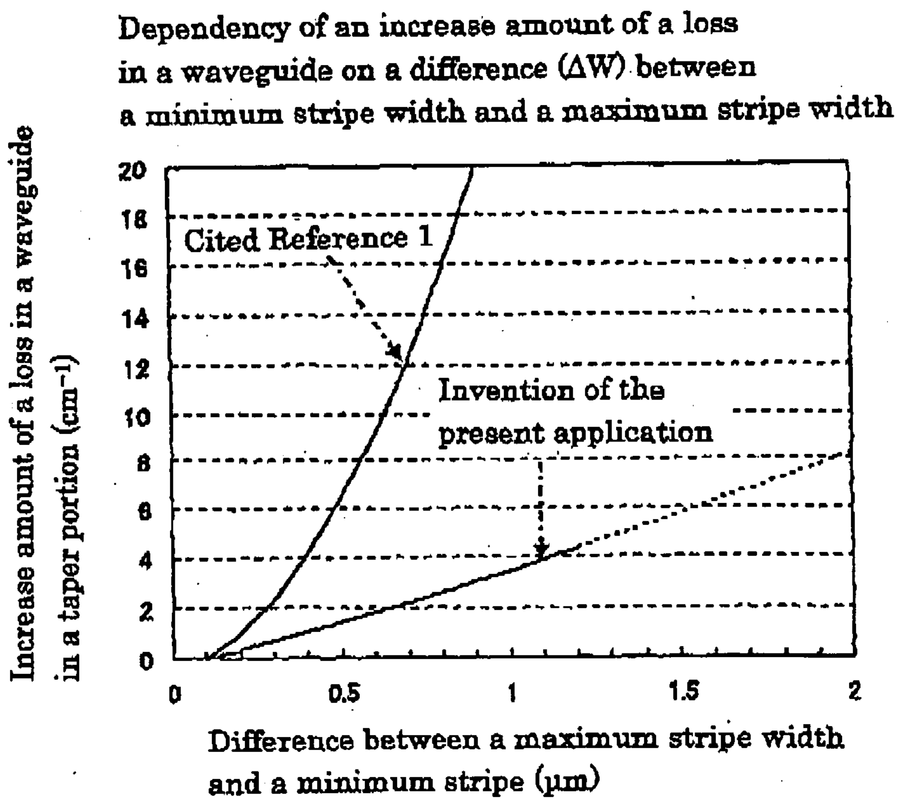
The invention of claim 6 produces significant results that are different in kind from Shimoyama et al. for the following reasons. First, the present first region being 10-50% with respect to the resonator length advantageously reduces the differential resistance in current-voltage characteristics and thus enhances significantly the temperature characteristics and reliability of the semiconductor laser device. On the other hand, the Shimoyama et al. central region is much longer relative to the resonator length and thus has a much higher differential resistance (Rs). This in turn requires a relatively high operation power, which will lead to substantial degradation of the temperature characteristics and reliability of the semiconductor laser device.

Second, in the present case, since the first region is at most 50% of the resonator length, the second region can be sufficiently long so that a sharp increase in the taper angle of the second region can be avoided. This advantageously suppresses the increase of a waveguide loss, and in turn suppresses the decrease in slope efficiency. This is demonstrated in Graphs 1 and 2 and will be discussed in detail below.

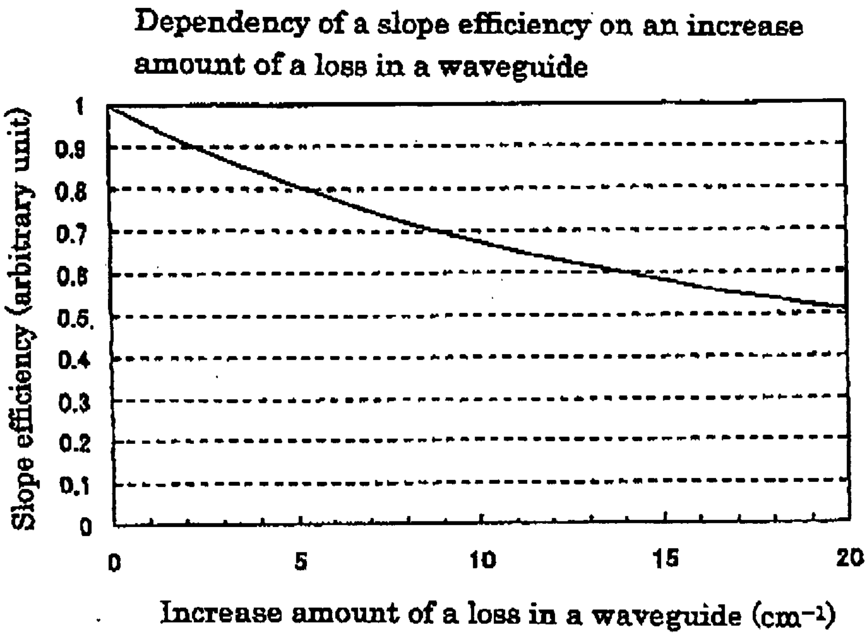
The curve designated by "Cited Reference 1" in Graph 1 illustrates the width difference ΔW between the maximum and minimum widths of the bottom of the ridge in Shimoyama et al. verses the increase of the waveguide loss. The curve designated by "Invention of the present application" illustrates the maximum width difference ΔW verses the increase of the waveguide loss in the present case.

In the present case, the width difference ΔW is calculated by the equation ΔW = 3 μm – 1.8 μm = 1.2 μm, wherein 3 μm is the maximum width of the second region and 1.8 μm is the minimum width of the first region as required by claim 16. As shown in Graph 1, the increase of the waveguide loss corresponding to ΔW of 1.2 μm appears to be less than 5 cm^{-1}. The slope efficiency in turn decreases by at most 20%, as illustrated in Graph 2. Therefore, the invention of claim 16 provides satisfactory light output. On the other hand, in Shimoyama et al., the range of the width difference ΔW is between 0.2 μm

and 1000 μm (see Shimoyama et al., paragraph [0027]). As a result, the light output can be significantly decreased in this configuration. For example, when the width difference ΔW is greater than 1 μm, the increase of the waveguide loss exceeds 20 cm^{-1}, as shown in Graph 1. Consequently, the decrease in slope efficiency is about 50%, as shown in Graph 2. This indicates a significant decrease in the light output. For the reasons above, Applicant respectfully submits that the present first region being 10% to 50% to the resonator length does indeed produce significant results that are different in kind from the configuration of Shimoyama et al.



Graph 1



Graph 2

For at least these reasons, claim 16 is patentable over Shimoyama et al. Claims 18-20 and 22-23 depend from claim 16 and are patentable along with claim 16 and need not be separately distinguished at this time. Applicant is not conceding the relevance of the rejection to the remaining features of the rejected claims.

Claims 24-28 are rejected under 35 USC § 103(a) as being unpatentable over Shimoyama et al. in view of Doi et al. (US 5,679,947). Applicant respectfully traverses this rejection. The rejection of claims 27 and 28 is moot in view of the cancellation of the claims. Claims 24-26 depend from claim 16 and are patentable over Shimoyama et al. and Doi et al. for at least the same reasons discussed above regarding claims 16, 18-20 and 22-23. Doi et al. do not remedy the deficiencies of Shimoyama et al. Applicant is not conceding the relevance of the rejection to the remaining features of the rejected claims.

New independent claim 30 is patentable over Shimoyama et al. for reasons similar to those discussed above regarding claim 16. Claim 30 requires a width of a bottom portion of a ridge in a first region to be in a range of 1.8 μm to 2.5 μm, and a difference between the width of the bottom portion of the ridge in the first region and a maximum width of a bottom portion of a ridge in a second region to be 0.5 μm or less. Claim 30 also requires a length of the first region to be 10% to 50% with respect to a resonator length. Shimoyama et al. fail to disclose or suggest such configuration as recited in claim 30. For at least these reasons, claim 30 is patentable over Shimoyama et al.

In view of the above, favorable reconsideration in the form of a notice of allowance is respectfully requested. Any questions regarding this communication can be directed to the undersigned attorney, Douglas P. Mueller, Reg. No. 30,300, at (612) 455-3804.

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Respectfully submitted,

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Dated: April 25, 2008

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